CITY OF BRUNSWICK, MARYLAND

TRANSIT-ORIENTED DESIGN GUIDELINES

APPROVED BY MAYOR AND COUNCIL

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TRANSIT-ORIENTED DESIGN GUIDELINES

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INTRODUCTION

Rapid growth and development can create many challenges: traffic congestion, sprawl development, and poor air-quality are a few. These challenges, however, become surmountable when they are viewed as opportunities to find innovative ways to address growth-related transportation issues. The development of communities that are oriented to a variety of transportation modes is an innovative way to address growth issues, to support economic development, and to improve the community's quality of life.

Transit-oriented design (TOD) integrates land use, zoning, and transportation planning elements to promote higher-density, mixed-use development that is easily accessible by various modes of transportation. TOD embraces the concepts of "smart growth" and traditional neighborhood design by encouraging higher-density development in areas with existing public services and by encouraging interconnected street networks. Pedestrian accessibility and street-oriented site design are also important elements of TOD. Another important element of TOD is transit access design, which ensures that development sites are accessible by transit vehicles.

The purpose of these guidelines is to provide developers, planners, and appointed and elected officials with information about the benefits of transit-oriented design, and to encourage the use of design elements that make commercial and residential developments more transit-oriented. These guidelines should be used as a reference tool in the preparation and review of development plans, especially for development that will occur in the County's urbanized areas and other areas that will be served by public transportation.

Goals

Transit-oriented design guidelines will help to accomplish a number of goals and recommendations identified in Frederick County's Countywide Comprehensive Plan and in the Frederick County Transit Development Plan (TDP).

The following goals are identified in the Countywide Comprehensive Plan:

- The County shall accommodate transit, pedestrian, and bicycle access into the design of new development and in the highway planning process; and

- Frederick County shall encourage transit-oriented development adjacent to MARC stations and around the proposed stations along the I-270 transitway.

The Transit Development Plan recommends the following:

- Extend transit services to serve new higher-density residential developments, major new employment areas, and major concentrations of medical offices, health facilities, nursing homes, and other similar destinations;

- Improve transit services to make them more convenient for work- and school-related trips by providing more frequent services, and by minimizing on-board and wait times to the greatest extent possible;

- Provide a high-quality service and market the service so that it is an attractive alternative to persons with the choice of a private automobile as well as those dependent on public transit;

- Encourage transit-friendly design for residential, commercial, and employment development that provides convenient access to transit for pedestrians and persons with disabilities; and

- Establish design standards and site plan review criteria for the County and the City of Frederick to ensure that new developments within the transit service area will accommodate transit vehicles.

Benefits of Transit-Oriented Design

TOD creates an environment that provides transportation choices. The design provides for safe and convenient transit and pedestrian access in addition to automobile access. The availability of transportation alternatives results in economic, environmental, and social impacts that benefit the entire community.

- Transit-oriented design provides the opportunity for people to choose among transportation alternatives, such as biking, walking, driving, or using transit.

- Reducing dependence on the automobile results in reduced traffic congestion, reduced fuel consumption, improved air quality, and a decrease in demand for new roads.

- TOD benefits transit systems by increasing ridership, increasing operating efficiency, reducing operating costs, and improving safety and access for transit vehicles.

- TOD provides greater pedestrian access throughout a development, which creates safer conditions for all pedestrians, including those who use transit. In addition to improved pedestrian access, TOD also provides pedestrian amenities, such as street trees, landscaping, lighting, pedestrian parks, and attractive architectural features. These types of amenities result in improved aesthetics, which often leads to a stronger sense of community and improves quality of life.

- TOD improves access to employment opportunities, housing, and goods and services for the general population. TOD provides significantly improved mobility for the transit-dependent population, which includes individuals who are too young to drive, senior citizens, people with disabilities, and people with low incomes. Frederick County's transit-dependent population is approximately 40% of the County's total population, based on 1990 Census data. This percentage is expected to increase with the aging of the baby-boomer population.

- TOD promotes a street network that is interconnected and direct, with multiple access-points, reducing the cost of providing public services such as transit, school bus service, snow plowing, mail delivery, and trash removal.

- TOD can result in lower development costs by minimizing parking areas and setbacks, reducing the amount of property required for development, and reducing infrastructure costs.

- The availability of multiple modes of transportation can be an economic development marketing tool to attract employers and employees. Also, because TOD results in improved access to employment, businesses located in such developments benefit from a broader labor market and a larger customer base.

- The goals of Maryland's Smart Growth programs are to support and enhance existing communities, preserve natural and agricultural resources, and save taxpayer dollars by reducing the cost of unnecessary new infrastructure. Transit-oriented design enhances and stabilizes existing communities by making transportation alternatives more accessible, convenient and efficient, which increases ridership and maximizes the public investment in transit. Public transit is an amenity which improves the community's quality of life and attracts residential and commercial developers as well as new businesses.

ELEMENTS OF TRANSIT-ORIENTED DESIGN

The four fundamental elements of transit-oriented design are pedestrian and bicycle accessibility, transit-oriented street networks, land use, and site design.

Pedestrian and Bicycle Accessibility

Pedestrian accessibility is one of the most important elements of transit-oriented design. Convenient and efficient pedestrian access promotes walking as an alternative mode of transportation and ensures access to other forms of transportation, particularly transit. Safe, convenient, continuous, and direct pedestrian access ensures accessibility for the transit-dependent population and promotes transit as an alternative for people who choose not to drive.

A 1990 survey indicated that the median distance transit users were willing to walk to a bus stop was just over one-quarter mile. The number of transit trips decreased dramatically when the distance walked to a bus stop was greater than three-quarters of a mile (Figure 1). Therefore, to encourage transit use, pedestrian access and amenities should be provided within a one-quarter to one-half mile radius around bus stops.

Bicycle accessibility is also important. Bike lanes adjacent to roadways and bike paths through new and existing neighborhoods provide a safe and convenient transportation alternative.

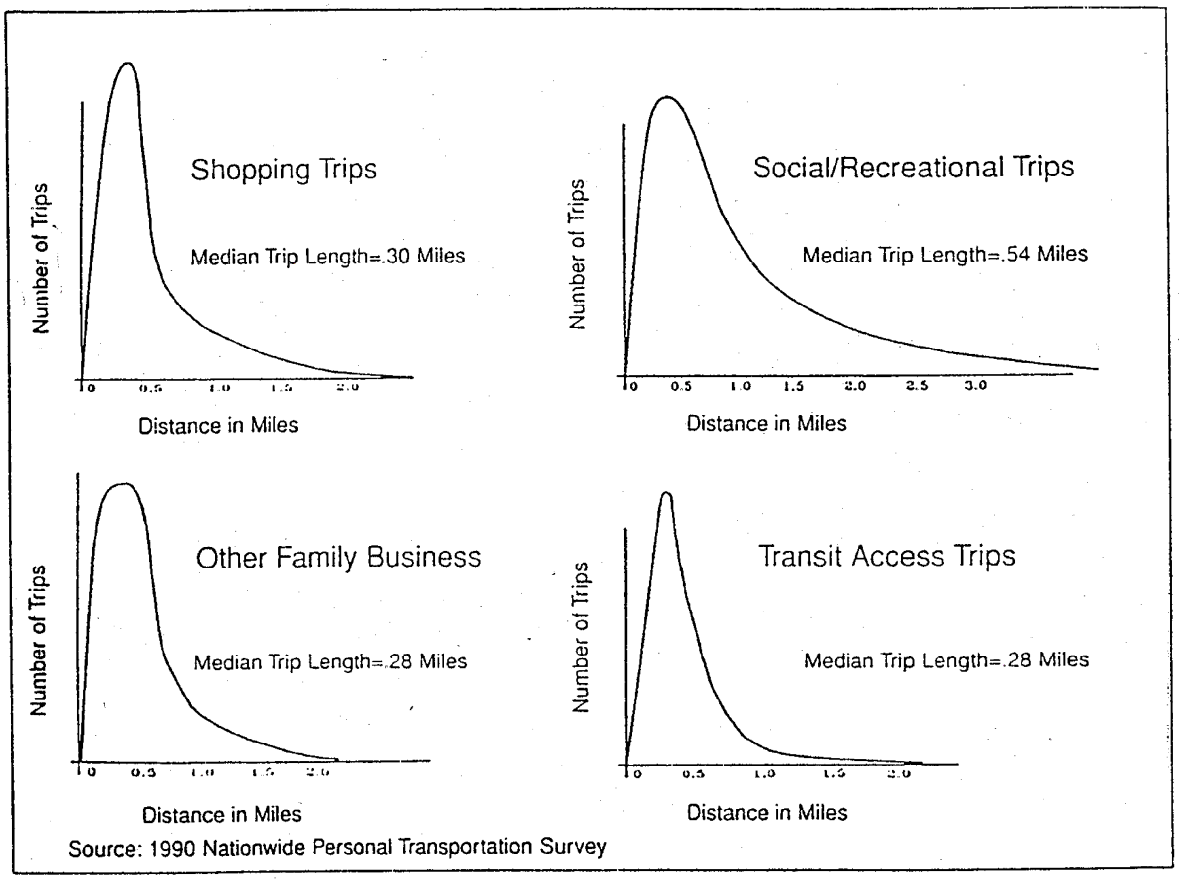
Recommended design elements for pedestrian and bicycle accessibility are:

- safe pedestrian crossings at intersections;
- sidewalks provided along all newly constructed streets and added to existing streets where gaps exist. Sidewalks should be a minimum of five (5) feet wide with a minimum three (3) foot planting strip (wider along busy arterial streets) between the sidewalk and the curb for safety purposes;
- bicycle lanes adjacent to roadways and bike paths through new and existing neighborhoods, particularly in areas near major transit stops;
- adequate street lighting for safety and convenience;
- landscaping and street trees for aesthetic purposes;
- awnings and overhangs for weather protection and other architectural features for aesthetic purposes;

- pedestrian parks, benches, and other amenities to generally improve the pedestrian environment; and

- bicycle racks or lockers at major transit stops to encourage bicycle riding as a transportation alternative.

Figure 1
Relationship between Walking Distance and Trip Purpose

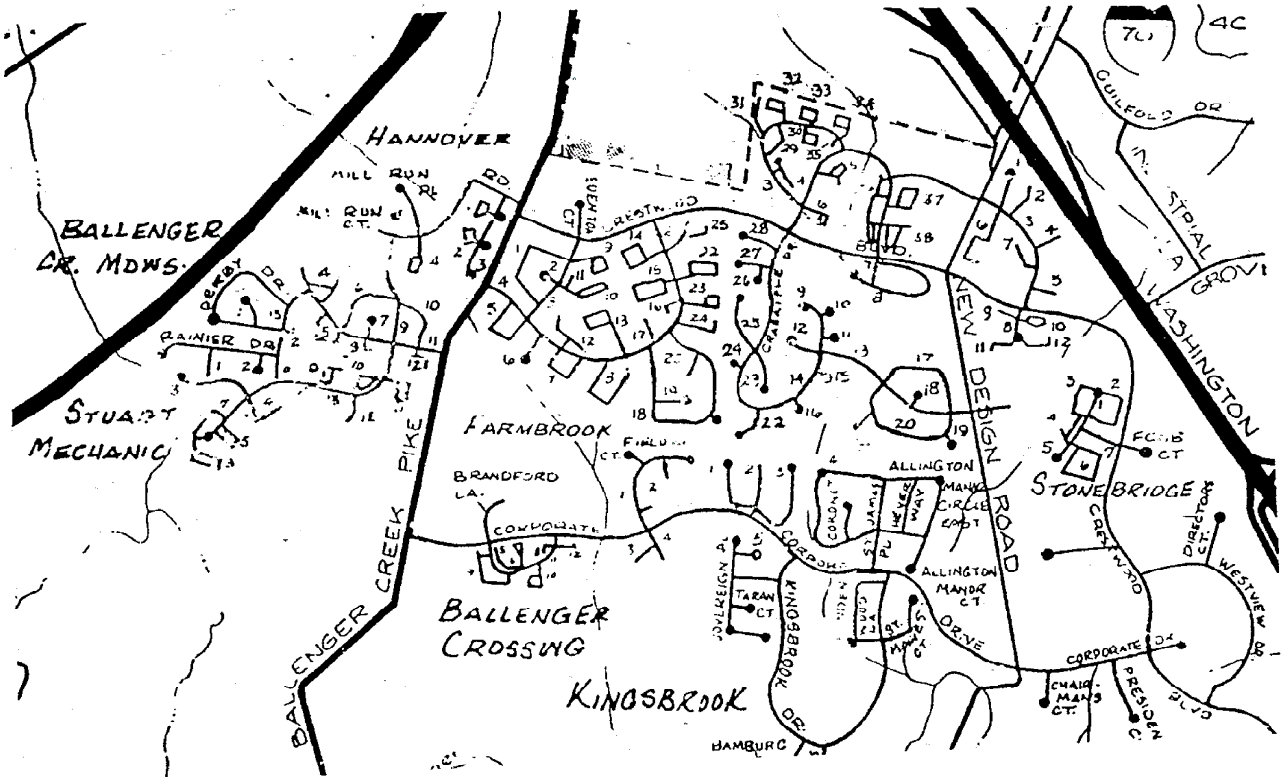


Source: 1990 Nationwide Personal Transportation Survey

Transit-Oriented Street Network

Pedestrian access is predicated on a street network that is interconnected, and provides direct and convenient access to various uses or transportation alternatives, such as transit stops. Over the last 30 years, the typical street pattern used in residential developments included a spine arterial road intersected by few curvilinear local streets that terminate in dead ends and cul-de-sacs. Often, streets constructed in new, adjacent developments do not connect with existing streets, exacerbating the problem of disconnected streets. This type of street pattern reduces pedestrian access and is not conducive to efficient transit operation, because buses must be routed through individual neighborhoods or there must be more stops along the spine road to adequately serve the area, adding considerable time and distance to the bus route.

Figure 2
Disconnected Street Pattern



Transit-oriented street networks include interconnected street patterns, which provide direct pedestrian access through neighborhoods to a centrally located bus stop. Street networks with characteristics of modern, curvilinear networks, as well as grid networks, may be considered transit-oriented as long as pedestrian paths creating short, direct connections are provided.

Figure 3
Interconnected Street Network

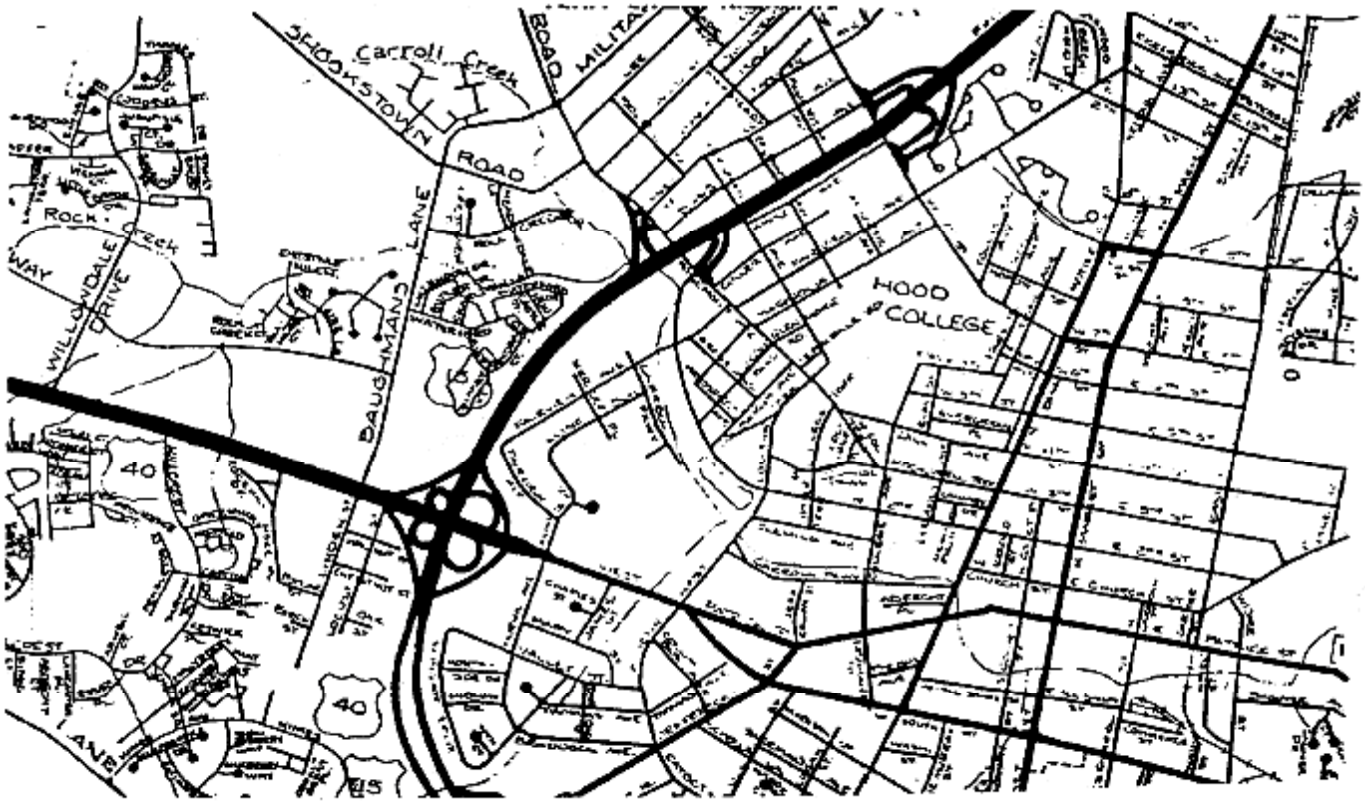


Figure 3 is an example of a street network that provides several advantages for transit service. The interconnected street pattern provides multiple routes for pedestrians and direct access through the neighborhood to the bus stop, allowing a centrally-located bus stop to serve a greater area.

In commercial and employment areas, a transit-oriented street network would include service roads or public streets that run parallel to heavily-traveled, high-speed, multi-lane arterials, providing a safe location for bus stops and convenient pedestrian access to businesses. Because of the safety hazards of locating bus stops on arterial roads, transit vehicles currently must enter shopping centers and business parks in order to serve them, which adds time and travel distance to the bus route, reducing operating efficiency and customer convenience.

Land Use

The two most critical land use issues in transit-oriented design are density and mixed-use developments.

Density - Studies show that transit use increases with higher land use density. Higher density residential uses, such as multi-family developments, generate more transit ridership because the population of multi-family developments tends to have lower automobile ownership rates and lower family incomes. Developing higher density residential uses along existing and planned transit routes not only ensures access to transit, but is consistent with "smart growth", which encourages development where services already exist.

One way to ensure that higher density residential uses are developed in the transit service area is to require minimum, rather than maximum, densities. To achieve minimum densities, lot sizes for single-family detached units can be reduced, and units can be clustered. Zero lot-line provisions can be applied in smaller-lot single-family subdivisions. Also, a variety of attached housing types could be utilized to achieve higher densities. Implementing a critical areas density transfer program and providing incentives such as density bonuses and fast-track permitting will result in transit-oriented development.

Mixed-Use Development - Transit-oriented design promotes development that includes a mix of residential, commercial, and employment uses. In more urban areas, these uses may be mixed within a single building, while in suburban areas the different uses may be clustered in a group of several buildings.

The primary benefit to mixed-used developments is that the close proximity of residential, commercial, and employment uses encourages the use of alternative modes of transportation and reduces dependence on the automobile.

Impact fee waivers and fast-track permitting could be provided as incentives for mixed-use developments.

Site Design

Commercial and office developments are typically separated from the street by vast parking areas that offer poor pedestrian access and discourage transit use. Pedestrians perceive walking across large parking lots as unsafe and inconvenient. Furthermore, it is time-consuming and inefficient for transit systems to drive through every strip mall and office park in order to stop at safe locations that are convenient for transit users.

Local zoning ordinances tend to require that shopping centers and office buildings have adequate parking to handle peak usage, which may only occur once or twice for a limited time throughout the year. A transit-oriented approach imposes parking maximums rather than parking minimums to limit the amount of parking for each use, so that parking provided is adequate to accommodate average demand. On-street parking should be allowed where practical to accommodate higher-than-average demand. Finally, encouraging shared parking among uses reduces the amount of parking area required, while providing plenty of parking around the clock. For example, in a mixed-use development that features shopping, office space, restaurants, and residential uses, the same parking spaces that are occupied during the day by office employees can be used in the evening by residents and patrons of the shopping center or restaurants.

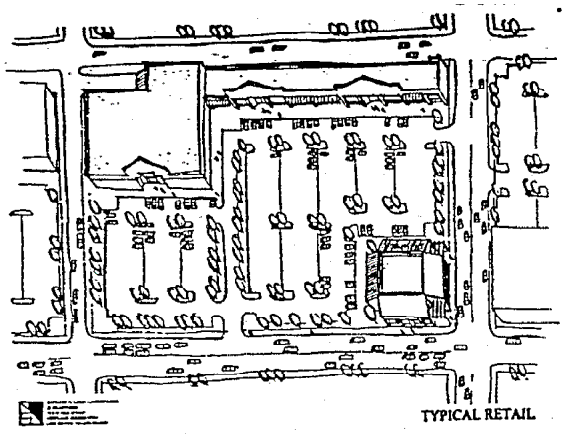
To encourage transit use, entrances to commercial and office buildings as well as multi-family residential developments should be oriented to the street to minimize the distance between the entrance and sidewalks or bus stops. Parking should be located to the sides and rear of the site. If parking must be located between the building and the street, an additional sidewalk connecting the entrance of the building to the street sidewalk should be provided.

Transit-oriented design encourages the use of the following elements:

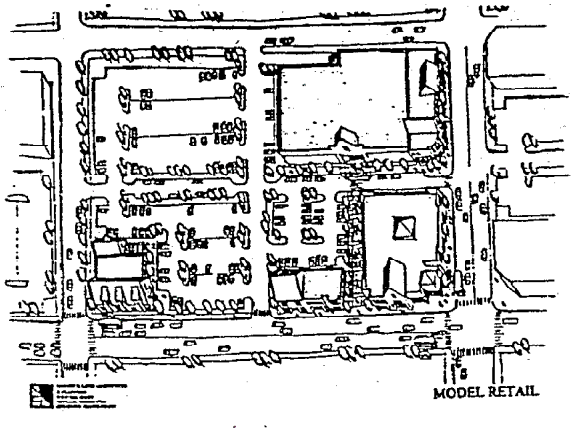
- shared parking between adjoining uses;
- on-street parking where practical;
- minimum parking requirements that more closely match demand; and
- maximum parking limits.

The following figures are examples of typical shopping center and office park layouts and how they can be redesigned to be more transit-oriented.

Figure 4
Commercial Development

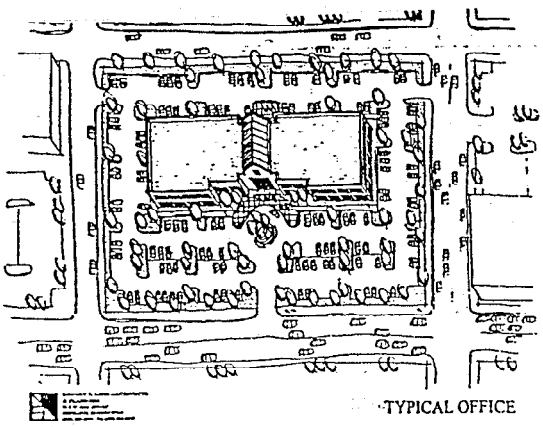


Typical one-story retail development with 4.5 spaces per 1,000 sq. ft. has a floor area ratio of 0.25.

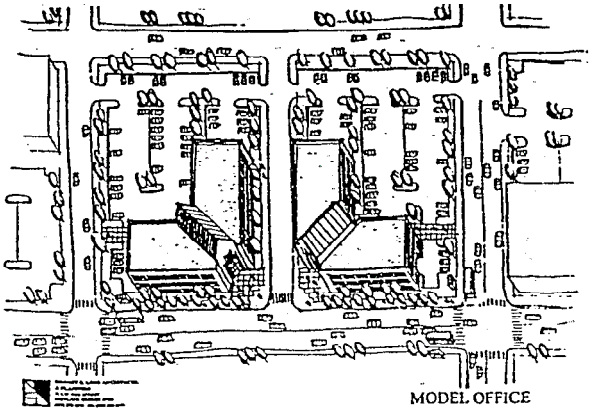


Increasing the height to two stories along one street and providing 3.5 spaces per 1,000 sq. ft. doubles the floor area ratio to 0.50.

Figure 5
Office Development



Typical two-story office development with surface parking has a floor area ratio of 0.5.



Increasing the height to three stories and reducing parking to three spaces per 1,000 sq. ft. doubles the floor area ratio to 1.0.

TRANSIT ACCESS DESIGN STANDARDS

The Maryland Department of Transportation and the Mass Transit Administration have established standards for the design of fixed-route bus stops, turnouts, and shelters, as well as turning radii at intersections. The transit access design standards were published in the *Maryland Transit Guidelines* (May 2002) for use by the development community in designing transit-accessible developments. Similar design standards should be incorporated into the appropriate local regulatory documents.

Design standards to ensure access by smaller vehicles used for paratransit services should also be considered. Facilities and developments that serve senior citizens and people with disabilities who may use paratransit services should be designed to include canopies or covered areas at entrances that are tall enough and wide enough to accommodate transit vehicles and to provide adequate weather protection for passenger loading. Parking areas should be designed so that smaller transit vehicles are able to enter and exit easily and quickly without having to back up and without impeding the normal traffic flow.

Vehicle Specifications

TransIT currently has a fleet of 30-foot buses, 28-foot buses, small (<24') buses, and vans/minivans. TransIT plans to add new 30' buses to its fleet in the coming years. The specifications/dimensions of these vehicles are noted in Figure 6. Turning radii standards provided in Appendix C are for buses up to 40 feet in length.

Figure 6
TransIT Vehicle Specifications

	Transit Bus	Shuttle Bus
Maximum Length	32'	24'
Maximum Width	96"	96"
Maximum Height	120"	115"
Weight (without passengers)	24,500 lbs.	10,500 lbs.
Turning Radius	33'7"	----

Bus Stops and Passenger Shelters

Bus stop and passenger shelter locations are based on the level of ridership activity at a given location. If the level of activity is high, or if the stop serves a major activity center, such as a hospital or community center, consideration should be given to installing a passenger shelter. New developments along existing or proposed transit

routes should include appropriate locations for bus stops with paved passenger boarding areas and, in areas with high ridership, passenger shelters. At layover points or at stops with higher ridership activity, concrete bus pads (Appendix B) should be incorporated into the design and construction of new streets.

Bus stops should be located where it is safe and convenient for passengers to board. Spacing of bus stops depends on the density and characteristics of the area served. In high-density areas, bus stops may be located every 450 feet; while in suburban areas, bus stops may be located every 1000-1200 feet.

Bus stops at large commercial and office developments should be centrally located or located on streets, rather than within the developments, to maximize the use of the stop and to minimize vehicle travel times and distances. Also, locating bus stops on the street rather than in parking areas minimizes interaction between transit vehicles, other motorists, and pedestrians.

Passenger shelters should also be located at stops with higher ridership activity to protect passengers from inclement weather and to provide them with a safe place to wait for the bus. Shelters should be oriented so that pedestrian and vehicular sight distance is not impaired and so that passengers within the shelter are able to see and be seen by approaching buses. Shelters should be enclosed on three sides, and should be positioned at least five feet from the curb, but near enough to provide quick access to the bus door. The open side of the shelter should be oriented toward the street. Additionally, passenger shelters must be handicapped accessible, and should be installed on a concrete pad. Walkways connecting the sidewalk, shelter, and street should be provided. To give TransIT a more visible identity, it is recommended that the passenger shelters have a unique design that is reflective of local architecture.

Appendix B identifies alternative bus stop locations and typical dimensions and layout for passenger shelters.

Additional amenities that may be provided in and near bus stops and passenger shelters are landscaping, public telephones, mail boxes, newspaper vending boxes, lighting, seating, and trash receptacles. Business and residential associations are encouraged to “adopt” shelters by providing and maintaining the shelter and passenger amenities, such as the landscaping and trash receptacles. Well-maintained bus stops and passenger shelters encourage transit use and enhance the aesthetics of the surrounding area.

IMPLEMENTATION OF TRANSIT-ORIENTED DESIGN STANDARDS

Effective transit-oriented design standards are implemented not only through comprehensive plan policies, but through inclusion in development regulations and consideration during the development review process. Currently, Volume 1 of the 1998 Frederick County Comprehensive Plan and the 1999 Frederick County Transit Development Plan recommend the adoption of transit-oriented design standards. However, in order to compel developers to use TODs, the goals and recommendations of the comprehensive plan must be translated into the development regulations of the zoning ordinance, subdivision regulations, and/or the design manuals.

The following elements of design are examples of those currently regulated by the zoning ordinance, subdivision regulations, and design manuals. These elements should be reviewed and revised to accommodate transit-oriented design standards.

Figure 7
Elements of Design

- Densities
- Setbacks
- Clustering
- Mixed-Use Developments
- Sidewalks
- Other pedestrian access
- Other pedestrian amenities
- Street landscaping
- Street lighting
- Parking
- Parking lot landscaping
- Parking lot lighting
- Alleys
- Cul-de-sacs
- Dead-end streets
- Entrance design/turning radii
- Lane widths
- Roadway paving/grades
- Intersection design

Until transit-oriented design is integrated into the City's development policies, the Transit Accessibility Checklist (Appendix A) should be utilized by local developers, planners, and appointed and elected officials to determine if proposed developments are transit-accessible.

CONCLUSION

Continued growth and development will bring challenges to Frederick County and the City of Brunswick that can be addressed through a shift in focus from automobile-oriented development to transit-oriented development in the County's urbanized areas and areas within the City of Brunswick that will be served by public transportation. Transit-oriented design will provide access to alternate transportation modes and will ensure that community transportation and other public services can be provided in an efficient manner by minimizing travel times and miles.

Transit-oriented design embraces the concepts of "smart growth" and traditional neighborhood design. TOD benefits the entire community through fundamental elements of design that can be included in existing development regulations and adopted as development policy. Implementation of TOD through revision of existing development policy is an innovative and proactive measure that can be used to overcome the challenges presented by growth and development and improve the quality of life for all citizens of Frederick County.

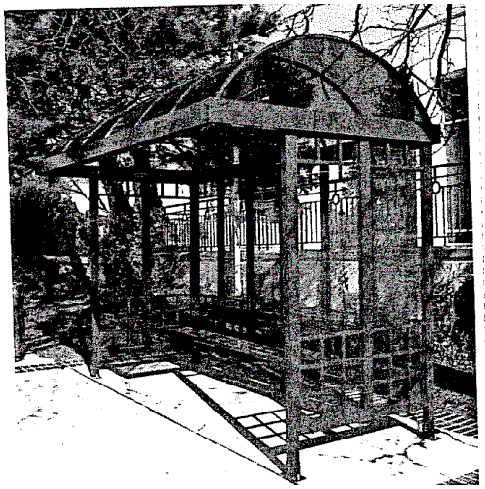
APPENDIX A: TRANSIT ACCESSIBILITY CHECKLIST

1.	Is the proposed development located within the current or planned transit service area?	Yes	No
2.	Is the proposed development expected to generate enough ridership activity to warrant transit service?	Yes	No
3.	Is the development designed so that efficient transit service can be provided (for example, buildings are oriented toward the street with parking areas located to the side and/or rear)?	Yes	No
4.	Is the development located on or accessible to a major roadway?	Yes	No
5.	If the proposed development is located on a major roadway, would a bus turnout be appropriate?	Yes	No
6.	Is a bus pad planned for bus layover points or bus turnout?	Yes	No
7.	Are the intersections, entrance radii, and lane widths adequate to accommodate buses?	Yes	No
8.	Is the street network interconnected, providing direct and convenient pedestrian access through the development?	Yes	No
9.	Are convenient pedestrian paths proposed between buildings and transit stops?	Yes	No
10.	Are the proposed pedestrian paths direct, well lit, wheelchair accessible, and paved?	Yes	No
11.	Are there safe, paved, well-lit, accessible areas for bus stops?	Yes	No
12.	Are the bus stops centrally located to serve as much of the development as possible?	Yes	No
13.	Is the proposed development expected to generate enough ridership activity to warrant a passenger shelter?	Yes	No
14.	Does the proposed passenger shelter meet safety and accessibility standards?	Yes	No
15.	Does the proposed passenger shelter provide passenger amenities?	Yes	No
16.	Have provisions been made to maintain the shelter and the surrounding area?	Yes	No
17.	If the development is in a commercial or industrial area, would a commuter parking lot be appropriate?	Yes	No

APPENDIX B: BUS STOPS

A bus stop is any on-street or off-street location where passengers board and alight a bus. Stops can be located in urban, suburban, and rural locations.

This section includes recommendations for three types of bus stop topics: **Spacing and Placement**, **Design**, and **Customer Features**. Each topic includes background information that explains and defines the topic and qualitative and/or quantitative recommendations. For some topics, implementation information is also provided.



SPACING AND PLACEMENT

Bus stop spacing and placement are important components for a transit agency to consider when creating a new route or modifying an existing route. Spacing should maximize ridership and promote efficient bus movement. Bus stop placement should maximize passenger safety and convenience both on the bus and traveling to and from the stop. Bus stop placement should also consider the safety of other roadway users.

BUS STOP SPACING

The table below lists ranges and typical spacing between bus stops for downtown core, urban, suburban, and rural locations.

Environment	Stops Per Mile	Typical Spacing (feet)
Downtown Core	10 to 12	450
Urban	5 to 10	750[1]
Suburban	4 to 6	1,000[1]
Rural	As needed	As needed

- **Downtown Core—**there should be 10 to 12 stops per mile in the high density commercial and business center (e.g., downtown Baltimore).

- **Urban settings—**there should be 5 to 10 stops per mile with variability given to the presence of individual travel generators (e.g., malls, hospitals, colleges, existing or proposed business, retail, and residential facilities). Abutting topography (e.g., slope, swale, drainage) may impact specific bus stop placement.

- **Suburban settings—**there should be 4 to 6 stops per mile with variability given to the presence of individual travel generators (e.g., malls, hospitals, colleges, existing or proposed business, retail, and residential facilities). Abutting topography (e.g., slope, swale, drainage) may impact specific bus stop placement.

- **Rural settings—**stops should be located at key crossroads and travel generators (e.g., malls, hospitals, colleges, existing or proposed business, retail, and residential facilities). Abutting topography (e.g., slope, swale, drainage) may impact specific bus stop placement.

BUS STOP PLACEMENT

Placement of On-Street Bus Stops

- Bus stops must be placed in locations where people can board and alight safely.

- All new bus stops must comply with ADA requirements.[2]

- Bus stops must be visible to street traffic.

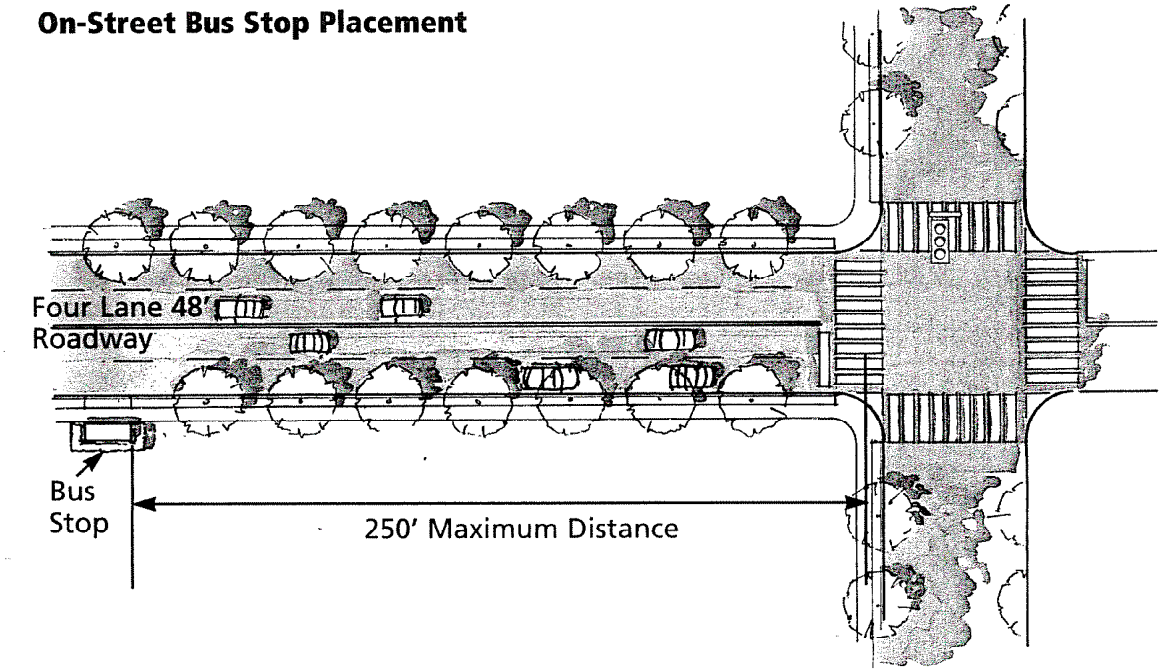
- Unless dictated by the existence of a travel generator, stops should be placed at intersections, preferably signalized intersections, to increase access to service and reduce pedestrians crossing a street at mid-block.

- At major transfer points, stops should be located so that transferring passengers do not need to cross a street to transfer. When there are multiple transfer movements at an intersection, the stop location should reflect the volume movements.

- On roadways greater than 48 feet wide with a posted vehicle speed limit of 35 mph or higher and traffic volumes greater than 400 vehicles per lane in peak hours or 5,000 vehicles per lane per day, bus stops should be located as close to the intersection as possible with a maximum of 250 feet to the signalized pedestrian crossing.

- Bus stop design, access, and location should be reviewed with the SHA District Engineer or the appropriate highway operating agency.

On-Street Bus Stop Placement

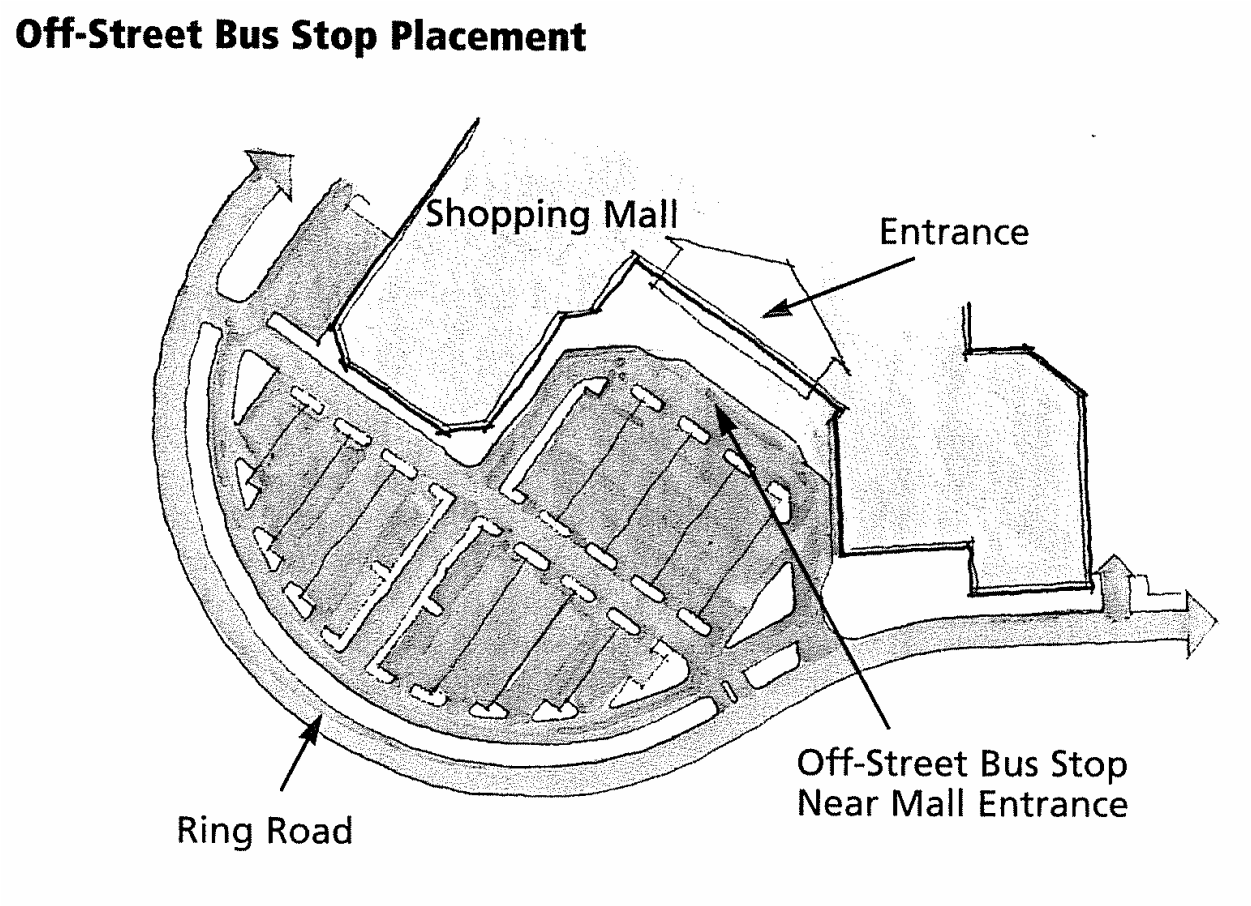


Placement of Off-Street Bus Stops

- Off-street stops should be used when large travel generators, such as a hospital or shopping mall, are set back from the roadway and would require walking an excessive distance.

- Off-street stops should be used when the location of the bus stop would cause passengers to cross the roadway at unsafe locations.

Off-Street Bus Stop Placement



FLAG STOPS

Flag stops are used by some transit agencies, typically in suburban and rural areas, where no designated bus stops exist. To board, the patron signals to the driver by waving. Transit agencies emphasize to riders that they should wait at safe, visible locations along the route where there is sufficient room for the bus to completely pull off of the roadway. To alight the bus, the patron asks the driver to stop. Similar to picking up a passenger, the bus driver should find a safe place to completely pull the bus off of the roadway.

- If flag stops are used, they should not be provided on roads with a posted speed limit exceeding 40 mph unless an adequate pull-off area is present.

DESIGN

BUS STOP GEOMETRICS

Bus stop geometric guidelines ensure that buses have adequate room to maneuver toward and away from the bus stop and to decelerate and to accelerate away from the stop based on roadway speed.

Bus stops should not be provided on roads with posted vehicle speed limits exceeding 40 mph unless a pull-off area is present. Right turn lanes and paved shoulders are acceptable pull-off areas.

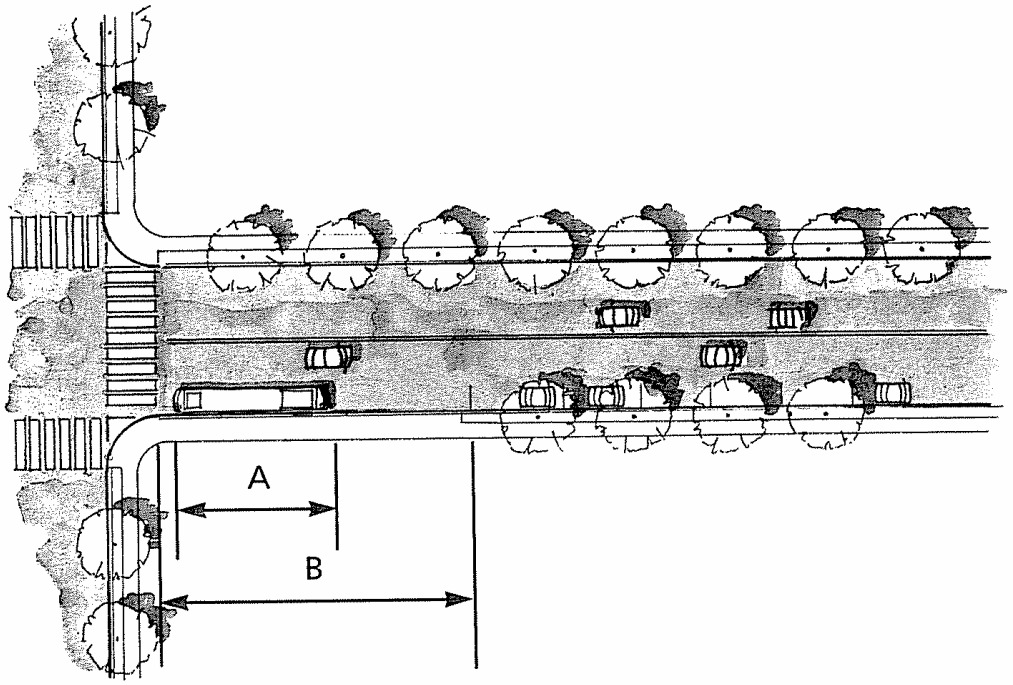
Sketches for bus stop geometrics are provided on pages 21 through 25 for Farside, Nearside, Mid-Block, Pull-Off, and Sawtooth stops. For bus stops with multiple routes, consideration can be given to increasing the total stop length.

Bus Stop Lane Width

- For all new on-street bus stops, the desirable width is the traffic lane or 12 feet, whichever is greater.

- For all new bus stop pull-off areas, the desirable width is 12 feet and the minimum width is 10 feet.

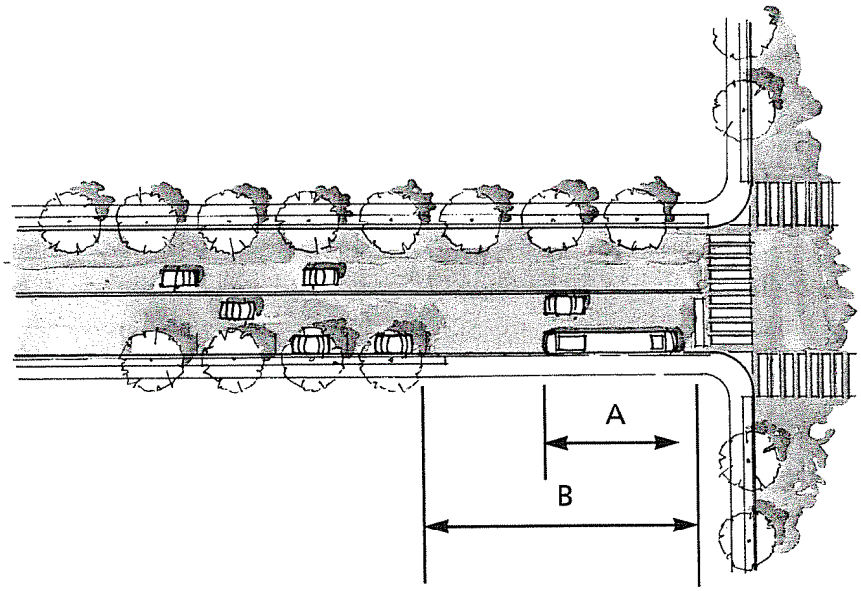
Farside Bus Stop



Bus Stop Length Recommendations

Posted Speed Limit (mph)	**A Bus Length** (feet)	**B Total Stop Length** (feet)
30 or Less	Less than 30	80
	30 to 45	90
	60	110
Over 30	Less than 30	120
	30 to 45	130
	60	150

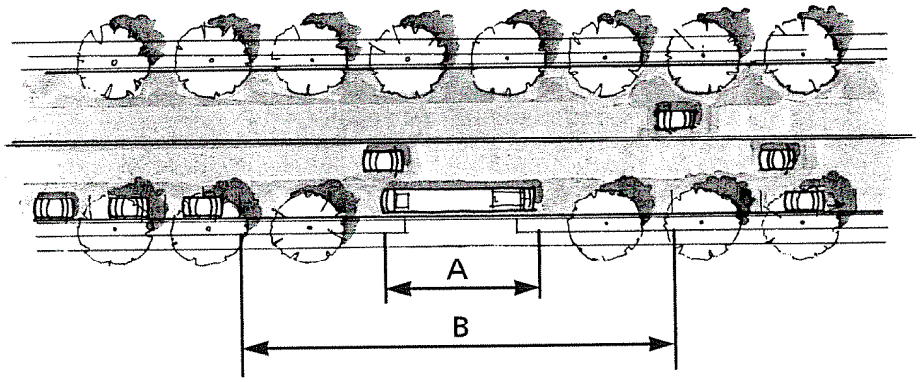
Nearside Bus Stop



Bus Stop Length Recommendations

Posted Speed Limit (mph)	**A Bus Length** (feet)	**B Total Stop Length** (feet)
30 or Less	Less than 30	100
	30 to 45	110
	60	130
Over 30	Less than 30	120
	30 to 45	130
	60	150

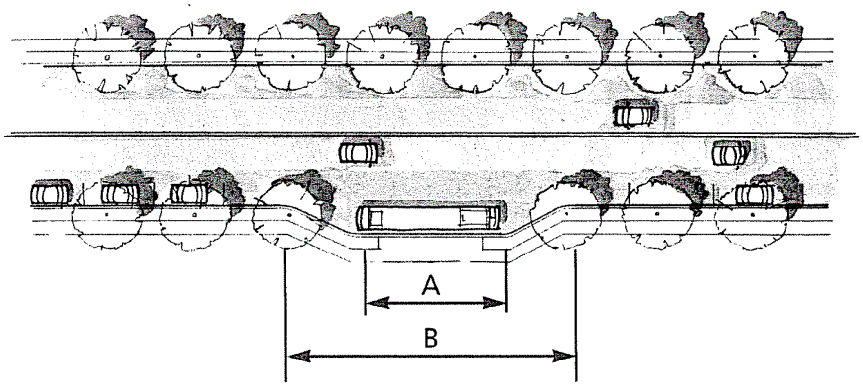
Mid-Block Bus Stop



Bus Stop Length Recommendations

Posted Speed Limit (mph)	**A Bus Length** (feet)	**B Total Stop Length** (feet)
30 or Less	Less than 30	140
	30 to 45	150
	60	170
Over 30	Less than 30	240
	30 to 45	250
	60	270

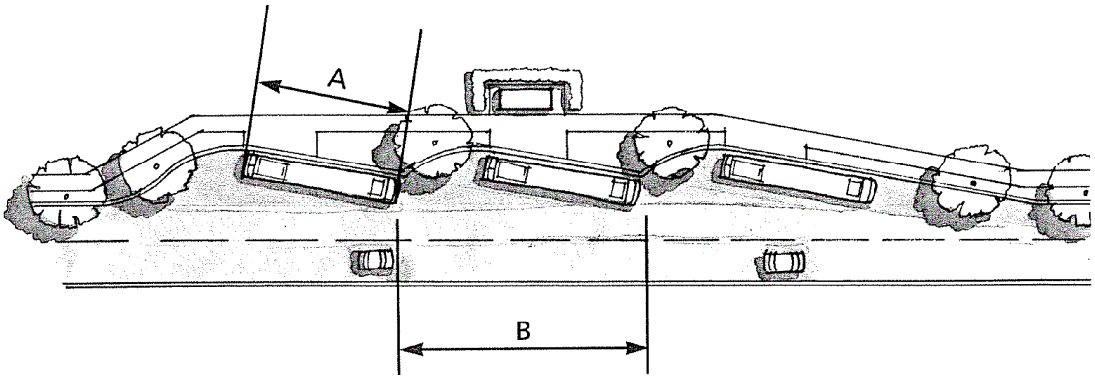
Pull-Off Bus Stop



Bus Stop Length Recommendations

Posted Speed Limit (mph)	**A** **Bus Length** (feet)	**B** **Total Stop Length** (feet) [entrance taper + curb stop area + exit taper]
30 or Less	Less than 30	140 [50 + 40 + 50]
	30 to 45	150 [50 + 50 + 50]
	60	170 [50 + 70+ 50]
Over 30	Less than 30	240 [100 + 40 + 100]
	30 to 45	250 [100 + 50 + 100]
	60	270 [100 + 70 + 100]

Sawtooth Bus Stop



Bus Stop Length Recommendations

Posted Speed Limit (mph)	**A Bus Length** (feet)	**B Total Stop Length** (feet) [curb stop area + exit taper]
30 or Less	Less than 30	55 [40 + 5 + 10]
	30 to 45	65 [40 + 15 + 10]
	60	85 [40 + 35 + 10]
Over 30	Less than 30	55 [40 + 5 + 10]
	30 to 45	65 [40 + 15 + 10]
	60	85 [40 + 35 + 10]

Bus Bulbs

Bus bulbs (also referred to as curb extensions, bulb outs, or nubs) are used to enhance the waiting area at bus stops. A bus bulb is a section of sidewalk that extends from the curb of a parking lane to the edge of the through lane. When used as a bus stop, the buses stop in the traffic lane instead of weaving into the bus stop that is located in the parking lane—therefore, they operate similarly to curb-side bus stops. Bus bulbs offer additional area for patrons to walk and wait for a bus and provide space for the patron amenities such as shelters and benches.

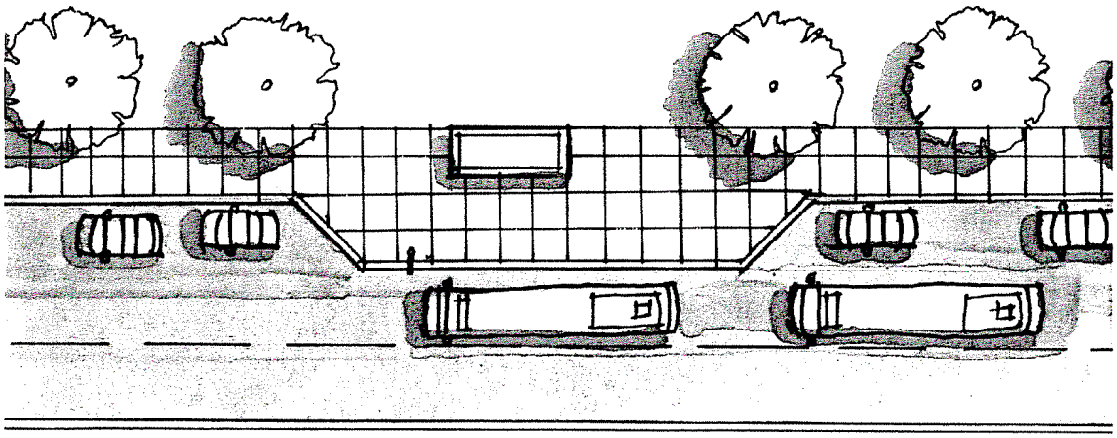
Bus bulbs have also been used as a traffic-calming technique. Bus bulbs reduce pedestrian crossing distances, create additional parking (compared with typical bus zones), and mitigate traffic conflicts between autos and buses merging back into the traffic stream. Bus bulbs should be designed to allow for an adequate turning radius for right-turn vehicles.

Bus bulbs should be considered at sites with the following characteristics:

- High pedestrian activity,

- Crowded sidewalks,
- Difficult pedestrian street crossings, and
- Bus stops in travel lanes.

Plan View of Bus Bulb



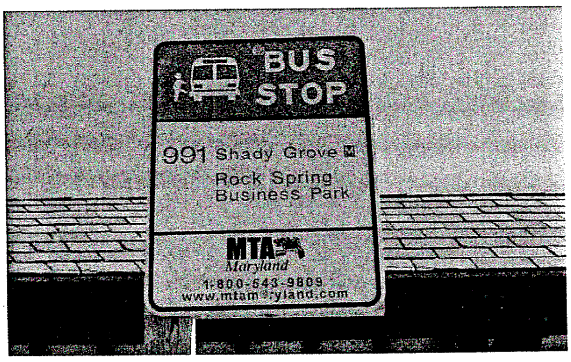
SIGNAGE

Bus stop signs serve many purposes. They mark stop locations and promote awareness of the transit system to the general public. Signage with detailed system information, such as route numbers, route destinations, and transit agency contact information, are valuable marketing and public awareness tools, but must be maintained to ensure the accuracy and validity of information.

Bus stop signs should be provided at all bus stops. Signs should be positioned at a safe location that is visible to street traffic. The following physical characteristics are recommended:

- Bus stop signs should measure 18 inches wide by 24 inches high.
- Bus stop signs should only display transit information.
- Parking regulations for the stop area should be on a separate sign. The restrictions should be consistent with local regulatory ordinances on parking. The parking regulation sign should be located so as to clearly communicate the location where parking is restricted.
- Appropriate color contrast, light lettering on dark background or dark lettering on light background, should be used.
- Individual transit agencies may choose any color scheme as long as the color contrast criterion is met.
- To comply with ADA requirements, bus stop signs must be at least 80 inches from the bottom of the sign to the sidewalk.

- If the roadway has curb and gutter, the pole supporting the sign should be at least 2 feet from the inner face of the curb.[3] If no curb is present, the pole supporting the sign should be more than 2 feet from the edge of the shoulder, or at least 6 feet from the edge of the travel lane.



The guidelines recommend that signs convey three types of information:

- Top Section –Defines that this is a bus stop.
- Middle Section—Lists bus route information.
- Bottom Section—Includes transit agency contact information.

Recommended Bus Stop Sign Layout

TOP: The words “BUS STOP” should be placed on the right side of the sign. The international bus stop symbol of a passenger boarding a bus should be located on the left side of the sign. The symbol and/or “Bus Stop” should be a minimum of 3 inches in height.

MIDDLE: This section shows the route identifier for the bus stop (e.g., letter, number, name, color, etc.) and is unique for each stop. The route identifier should be at least 3 inches tall where practical. If there is space, the route destination should follow the route identifiers. If the bus route provides service to a rail station or an airport, the station or airport name and logo should be listed if there is space. If multiple agencies serve the same bus stop, the transit agency logo or name precedes each route identifier so that it is clear which transit agency corresponds to which route.

Where practical, the text height for route information should be 3 inches. This is consistent with ADA guidelines that recommend a 3-inch letter height size on bus stop signs.[4] When it is not feasible to show all route information at the 3-inch letter height, the following guidelines should be used:

- In situations where there is only one agency providing service with only one route, the letter height for the route identifier should be 3 inches. The route destination should be displayed at 3 inches or as tall as possible to fit within the width of the sign either to the right of the route identifier or in a second row below. Multiple destinations for a single route can be written on one line and separated with a slash (/) or written on separate lines. If the route connects to another transportation mode, that mode’s logo should be shown to the right of the route destination.

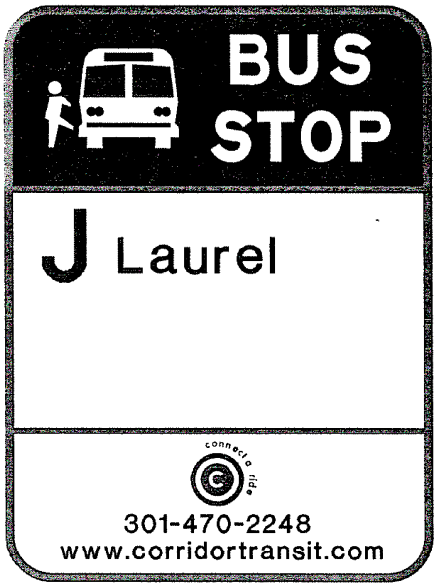
- For all other sign scenarios, multi-agency and/or multi-route, all information pertinent to a given bus route should be displayed as large as possible on a single line. Each bus route should be displayed on an individual row.

BOTTOM: The bottom part of the bus stop sign should display the transit agency’s logo. In the absence of an agency logo, the transit agency should use its name. Below the agency logo and/or name is the transit agency’s general system information telephone number. Below the phone number is the agency’s Web address. Similar to the phone number, the Web site should be a source for rider and trip planning information. If multiple transit agencies serve a particular stop, then the bottom section is split into equal areas and each of the transit agencies’ contact information is displayed within the smaller boxes.

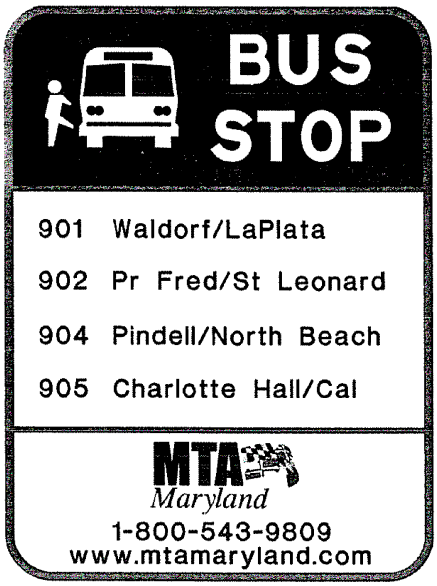
REVERSE SIDE: The reverse side of the bus stop sign should display the words “BUS STOP”.

The following bus stop sign examples are for single agency/single route, single agency/multi-route, and multi-agency/multi-route.

Single Agency/ Single Route Sign



Single Agency/ Multi-Route Sign



Multi-Agency/ Multi-Route Sign

ROADWAY PAVEMENTS

The areas where buses brake, accelerate, and turn should require special attention.[5] Unreinforced pavements, such as asphalt, deform with the weight and frequency of buses coming and going at the stop. During the summer months, the deterioration process accelerates when hot temperatures and sunlight soften the black asphalt. This deterioration of the pavement could lead to increased vehicle maintenance costs and customer complaints as a result of the rough, bumpy pavement. To address these issues, transit agencies should build pads at bus stops following the guidelines below:

- Locations where vehicles brake, accelerate, and turn should be paved with materials of sufficient strength to accommodate repetitive loads of a bus.
- The pad should be the width of the curbside lane for bus stops.
- The sizes of the pads vary from one agency to another based on the type of bus stop: curbside, open bus bay, queue jumper bus bay, or nubs. The concrete pad should be a minimum of 11 feet wide (preferably 12 feet) for bus bays.
- The pad length should accommodate the maximum number of buses stopping simultaneously and provide adequate distance for entrance and exit tapers.
- If a bus stop is located within private property that is not owned by the transit agency, then the transit agency should present options to the owner and discuss responsibility for installation and maintenance.

The table below lists recommendations for roadway pavements at urban, suburban, and rural bus stop locations.

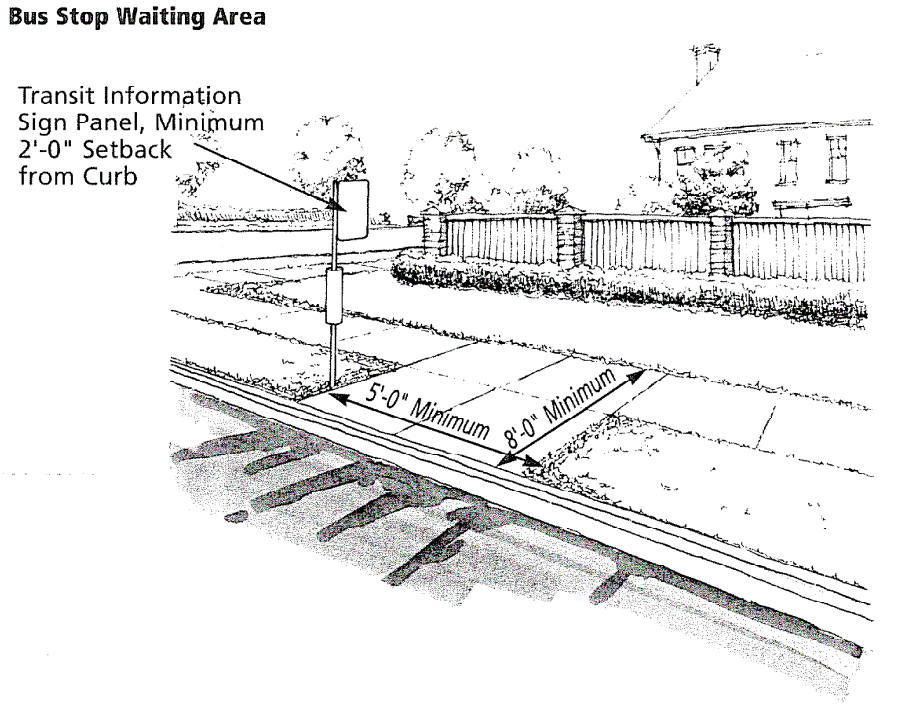
Bus Stop Environment	Recommendations
Urban	Reinforced concrete pads at urban bus stops
Suburban	Asphalt or reinforced concrete for suburban locations based on volume, service frequency, and stop type. Pads at transfer centers and multi-route locations should receive high priority.
Rural	Asphalt may be used unless high volume or stop significance warrants the installation of a concrete pad.

PEDESTRIAN SURFACES

Pedestrian surfaces are any hardened surface on which a patron boards or alights a bus. Transit riders should not wait for buses in the roadway or on unpaved surfaces. Pedestrian surfaces increase passenger safety by providing passengers with a durable, slip-free surface located away from the roadway. Pedestrian surfaces can also be designed to enhance the visual appearance of the stop by using artistic floor patterns or pavers.

The pedestrian surface must comply with ADA requirements and should:

- Be 5 feet wide by 8 feet deep.
- Consist of a hardened material such as concrete, asphalt, or pavers.
- Provide adequate visibility to approaching buses.
- Connect to adjacent sidewalks or another hardened surface to provide pedestrian accessibility to and from the bus stop location.



LIGHTING

Bus stops that are well lit provide patrons with an enhanced perceived sense of security and safety. Bus stop lighting also increases a bus driver's ability to see patrons waiting at a stop. At poorly lit stops, bus drivers may pass by bus stops with people waiting to board.

Illumination requirements currently vary among public transportation agencies. The generally accepted minimum threshold for sufficient lighting at bus stops ranges from 2 to 5 foot-candles.[6] The two primary cost considerations for lighting include initial installation cost and availability of power. The most cost-effective solution to provide lighting at a transit stop is to locate bus stops near existing street lamps. This practice is very common for transit service within urbanized areas.

Recent research has investigated the use of solar-powered transit stop lighting.[7] The primary benefit of using this type of power source is that it is self-generating. The battery used to operate the light at night is charged during the day by solar energy. This type of technology eliminates the need to be near an electric power supply.

Bus stop lighting is desirable and transit agencies are encouraged to work with the appropriate public agency to install lighting. Key recommendations relative to lighting are:

- Bus stops should be placed near existing lighting sources whenever possible. In most surroundings (urban, suburban, and rural), the need for a transit stop is within close proximity to a developed area where some lighting exists. In urban environs, this is especially true, since most street corner lampposts provide sufficient light for the corner and most of the mid-block area.

- It is recommended that vandal-resistant fixtures be used. Lampposts should not have exposed bulbs or elements.

- Lighting equipment should be easily accessible for repair and maintenance.

- Solar-powered transit stop lighting should be investigated and used when appropriate.

LANDSCAPING

Landscaping improves the area around a bus stop and can provide shade in the summer. Effective streetscape plans improve the appearance of a street and can make the area more pedestrian-friendly.

Bus stop landscaping is desirable. If transit agencies allocate funding towards trees and landscaping, the following guidelines are suggested:

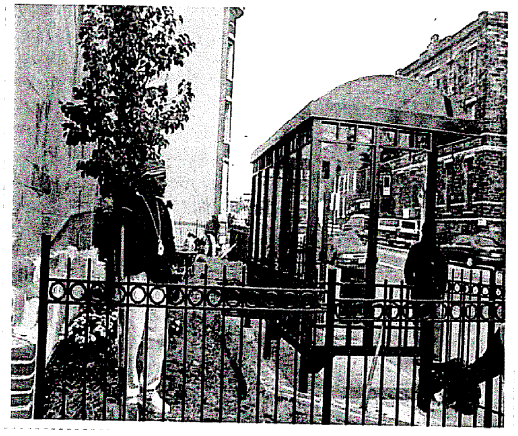
- Shade trees should optimize shading protection for the waiting customer at the bus stop.

- Avoid planting shallow-rooted trees that will damage sidewalks and concrete surfaces.

- Shrubbery should be planted at the discretion of the local jurisdiction.

- Shrubbery should be kept low to ensure visibility between the transit patron and transit operator.

- Encourage local jurisdictions or those responsible for right-of-way maintenance to groom and maintain trees, shrubbery, and grass.



CUSTOMER FEATURES

SHELTERS

A bus stop shelter serves as a visual marker for the bus stop and offers protection from wind, rain, and snow to waiting passengers. It also can provide visual and aesthetic interest. A minimum of 25 daily boarding passengers is recommended to warrant the installation of a bus stop shelter.

For all transit systems, the following installation guidelines should be used:

- The minimum design specifications are 3 walls (a rear and two sides) with a minimum covered area (under roof) of 48 square feet. For shelters with four walls, the front side must have two entrances. For areas with space limitations, other shelter types, such as umbrella or half-wall can be used.

- All shelters should have interior seating.

- All shelters should include a display case for transit information.

- Shelters should have a minimum front clearance of 3 feet (5 feet is desirable) from the shelter to the edge of the curb.[8]

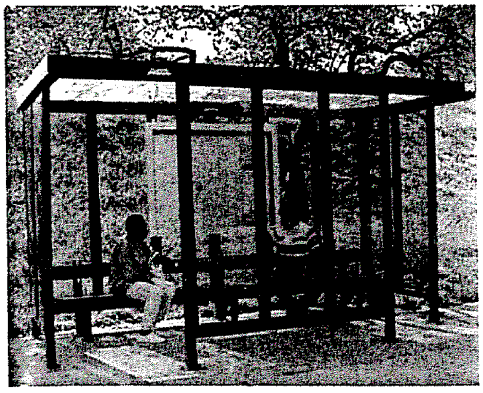
- All new shelters should comply with ADA guidelines.

- The shelter should be placed near the front of the bus stop and be visible to vehicle and pedestrian traffic.[8] The shelter should not be placed without giving due consideration as to how it might affect intersection operations, particularly sight distances for motorists and pedestrians.

- The shelter should be visually compatible with adjacent structures.

- The shelter side panel at the end where the bus approaches should be free from any obstruction (e.g., transit information panel or advertisement) that would block the view of an approaching bus.

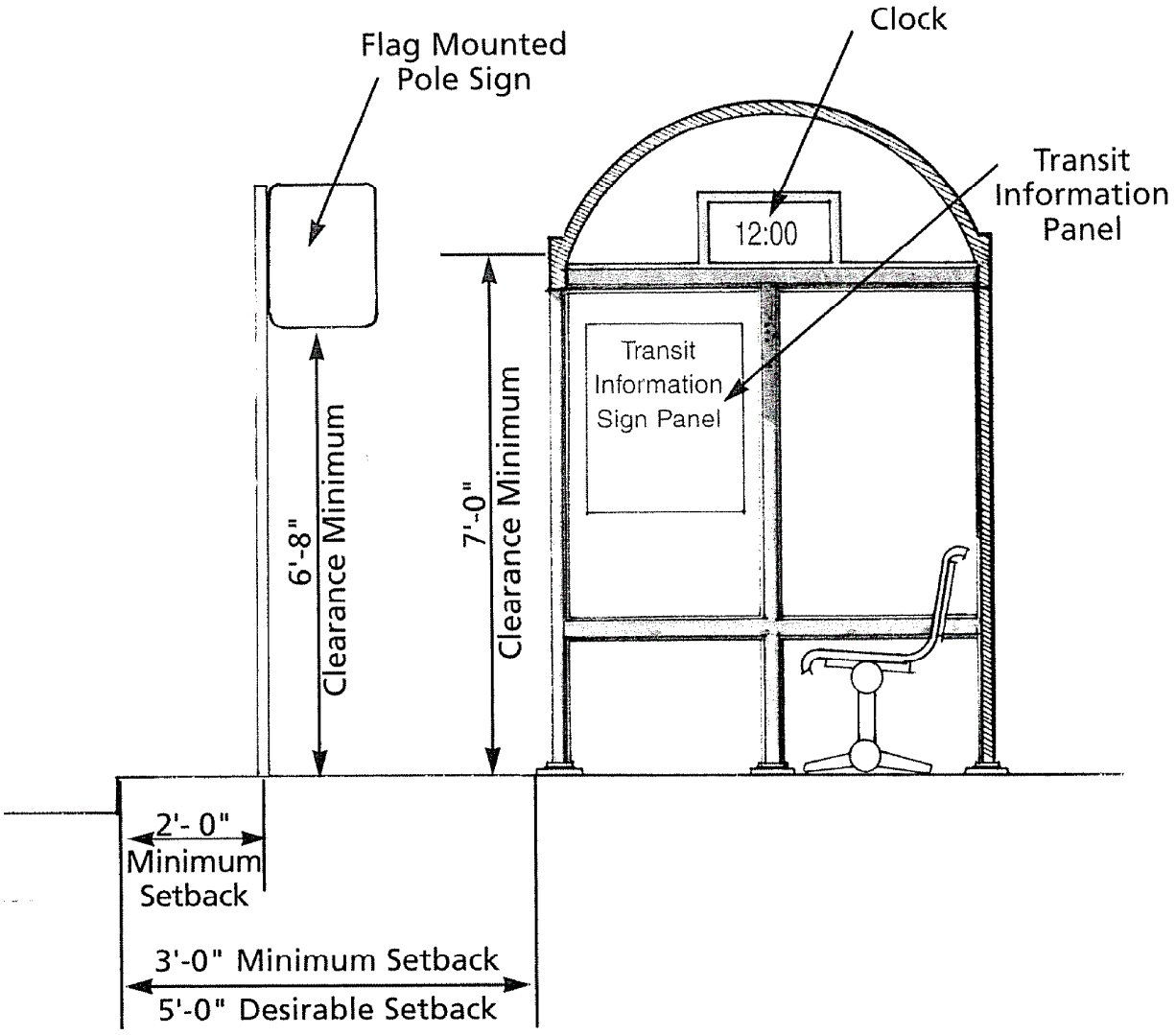
- Clocks are a desirable feature, but installation is left to the discretion of individual transit agencies.



For the maintenance and repair of bus stop shelters, the following guidelines are suggested:

- Shelter surfaces should be cleaned at least once every 6 months.
- Graffiti should be removed and any vandalized or broken equipment should be repaired as soon as possible.
- Shelter materials that minimize maintenance and vandalism should be used.
- Transit agencies are encouraged to establish “Adopt-a-Shelter” programs that encourage local businesses and organizations to maintain the shelter. Recognition should be given to the party adopting the shelter.

Bus Stop Cross Section

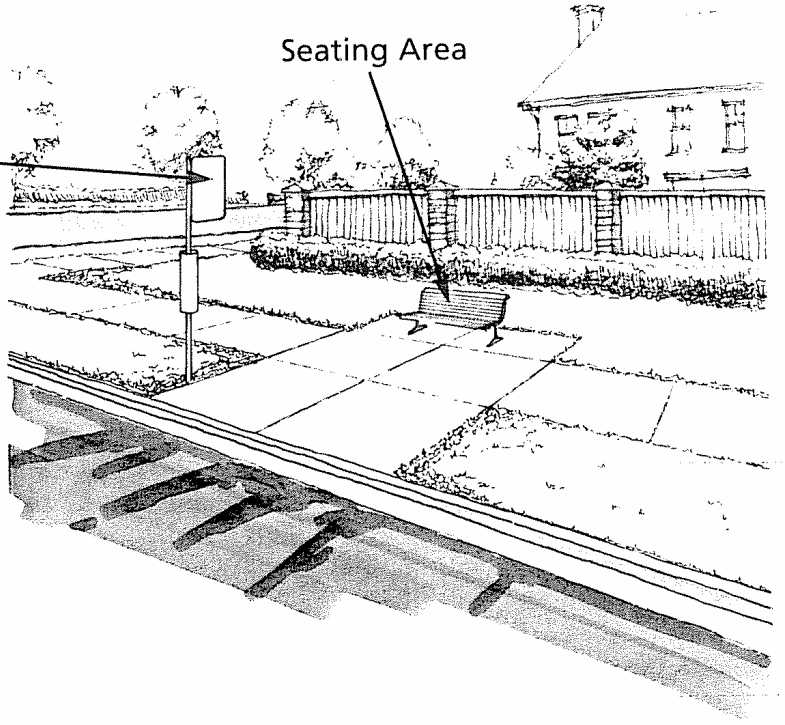


SEATING

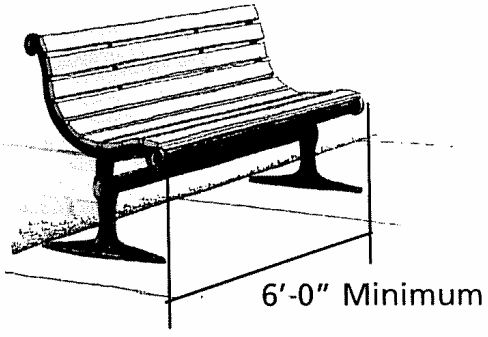
Bus stop seating increases patron comfort and reduces perceived waiting time.

- Stops with daily boards of at least 10 passengers warrant the installation of a bench.
- The minimum bench size should be 6 feet in width.
- The bench should be mounted and secured on a concrete surface.[9] The size of the surface may vary with each location, but should be consistent with ADA requirements.
- A minimum front clearance of 4 feet is recommended between the street curb and the edge of seat.[10]
- Seats or benches should be visible to traffic and be near the front of the bus stop.
- Transit agencies should use materials that minimize maintenance and vandalism.

Bus Stop with Bench



Recommended Bench Width

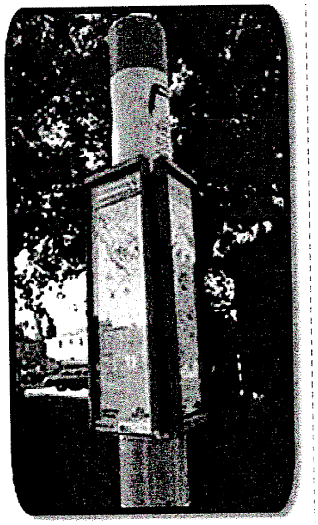


INFORMATION BOXES

Transit information at a bus stop helps passengers to use transit services. Information boxes are units that display transit schedules, maps, and other information. The box is typically mounted on a post or pole and can be multi-sided. Similar to an information box, a transit information panel contains transit timetables and maps. Information panels are usually mounted on bus stop shelter walls. It is critical that information provided be up to date.

- For bus stops that have more than 10 boardings and do not have a shelter, it is recommended that an information box be mounted on the sign pole below the bus stop sign.

- At a minimum, the transit information provided should include a route map for the route(s) serving the bus stop, a schedule/timetable for the route(s) serving the bus stop, and fare information.



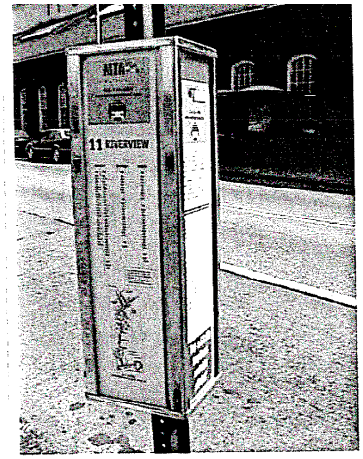


Photo courtesy of
Daytech Manufacturing, Inc.
www.daytechmfg.com

TRASH RECEPTACLES

Trash receptacles promote a litter-free environment at bus stops.

The recommendations for trash receptacles at bus stops include:

- Transit agencies will determine applicability on a case-by-case basis.

- The trash receptacle should be secured to the ground.

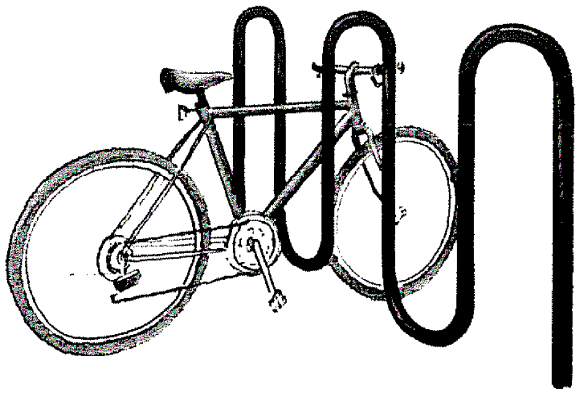
- Trash should be removed at least once a week.

- Transit organizations are encouraged to work with local jurisdictions, community groups, and neighborhood organizations to establish trash removal responsibilities. “Adopt-a-Stop” programs are written agreements with civic groups, businesses, or community organizations to help maintain the cleanliness of the bus stop.

BICYCLE STORAGE

- The guidelines recommend that transit agencies should install bicycle racks whenever a bus stop is near a bike trail and at locations where bicycle use by transit passengers is expected.

U-Channel Bicycle Rack

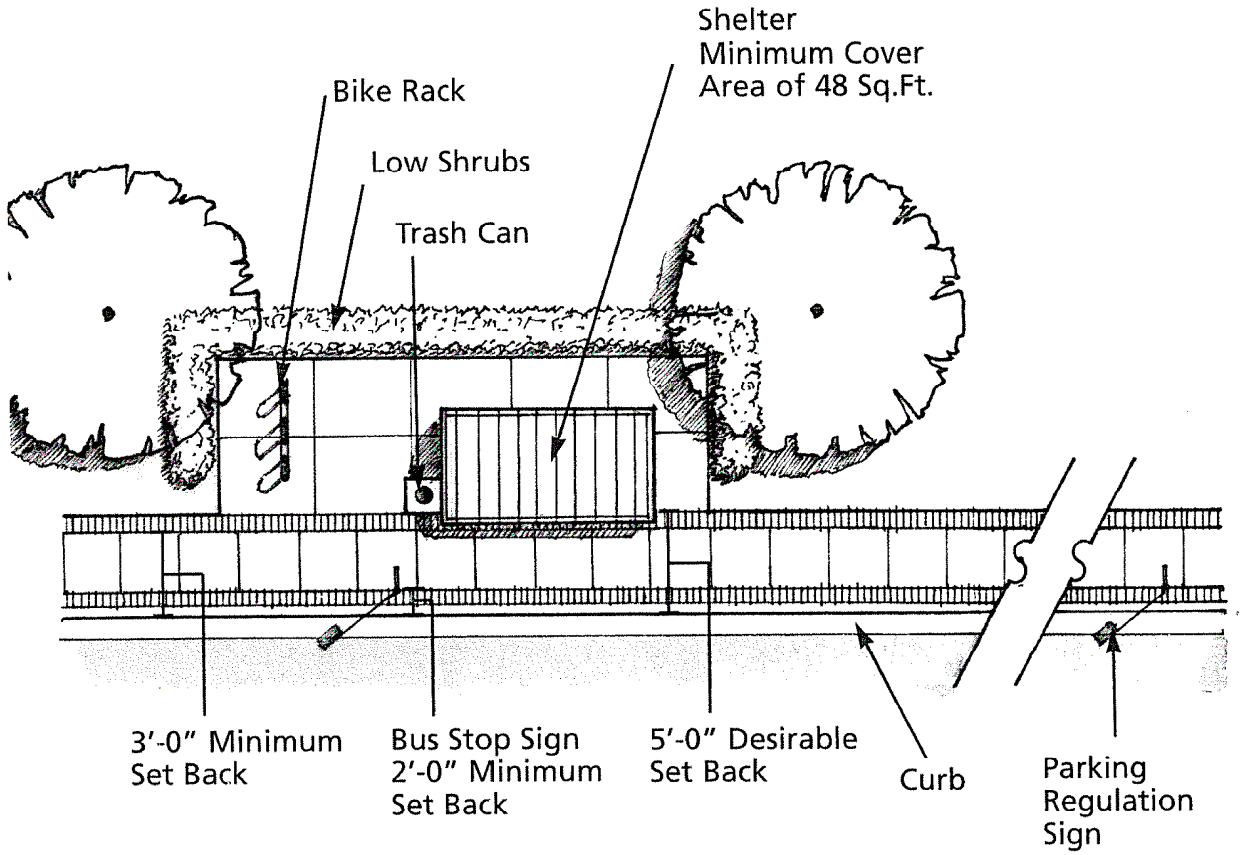


TELEPHONES

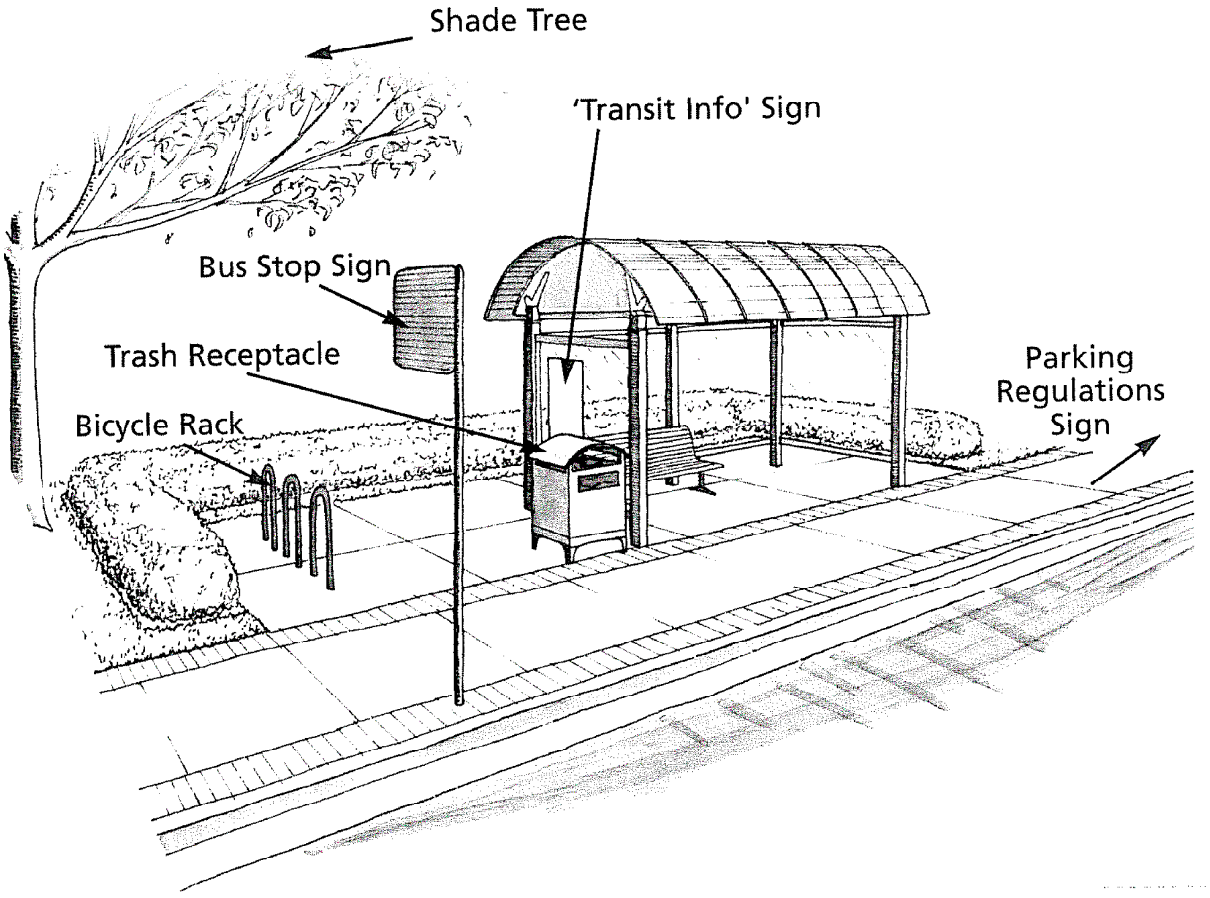
Telephones allow passengers to make travel arrangements such as being picked up from a stop by a taxicab or automobile. Telephones are also a valuable communication device during emergencies.

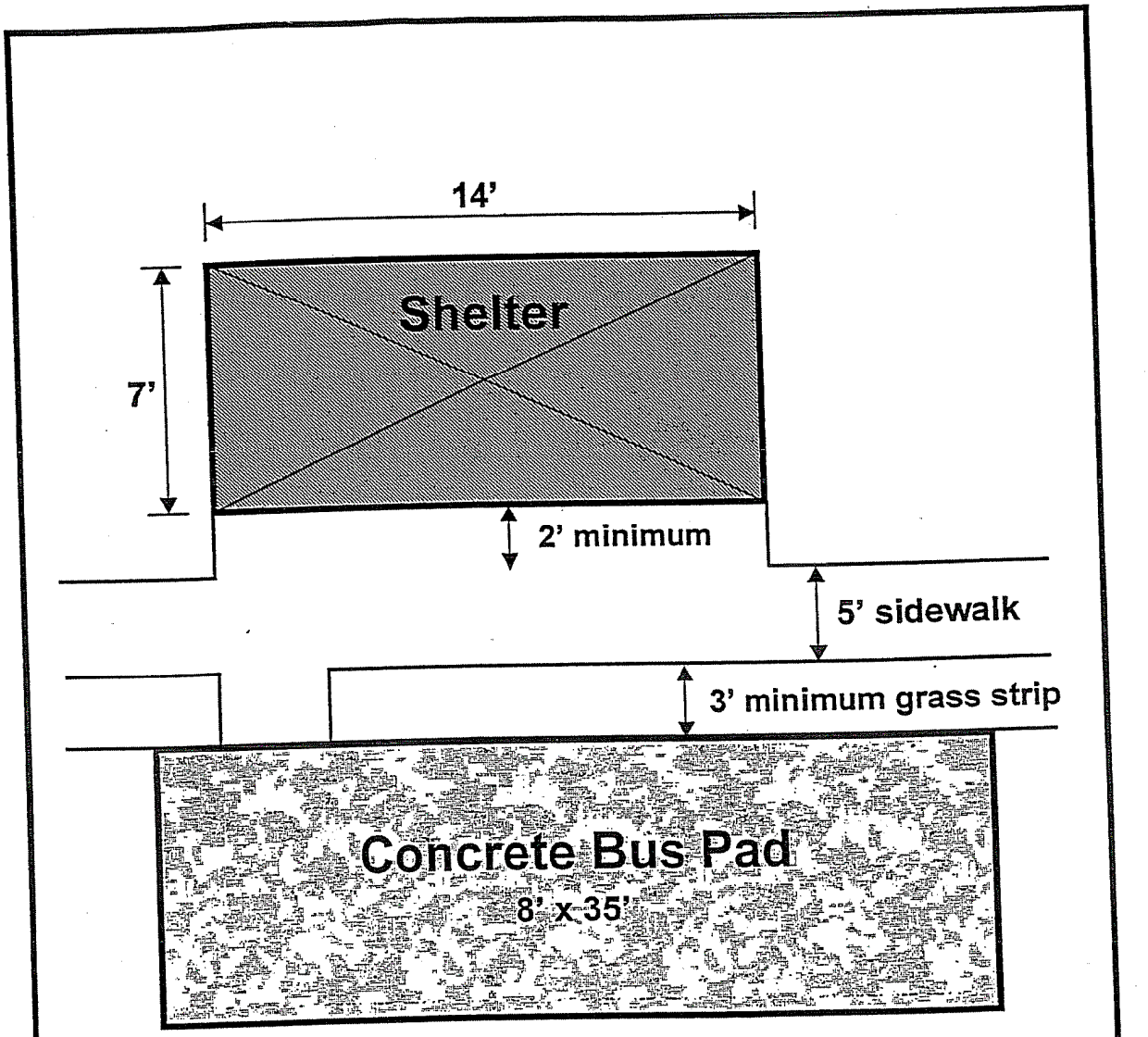
- Transit agencies should encourage telephone companies to install and maintain telephones at major bus stops.

Plan View of Bus Stop Layout



Recommended Bus Stop Layout





Typical Bus Shelter Layout

(Not to scale)

Transit Services of Frederick County

APPENDIX C: VEHICLE MANEUVERABILITY

Technical Specifications

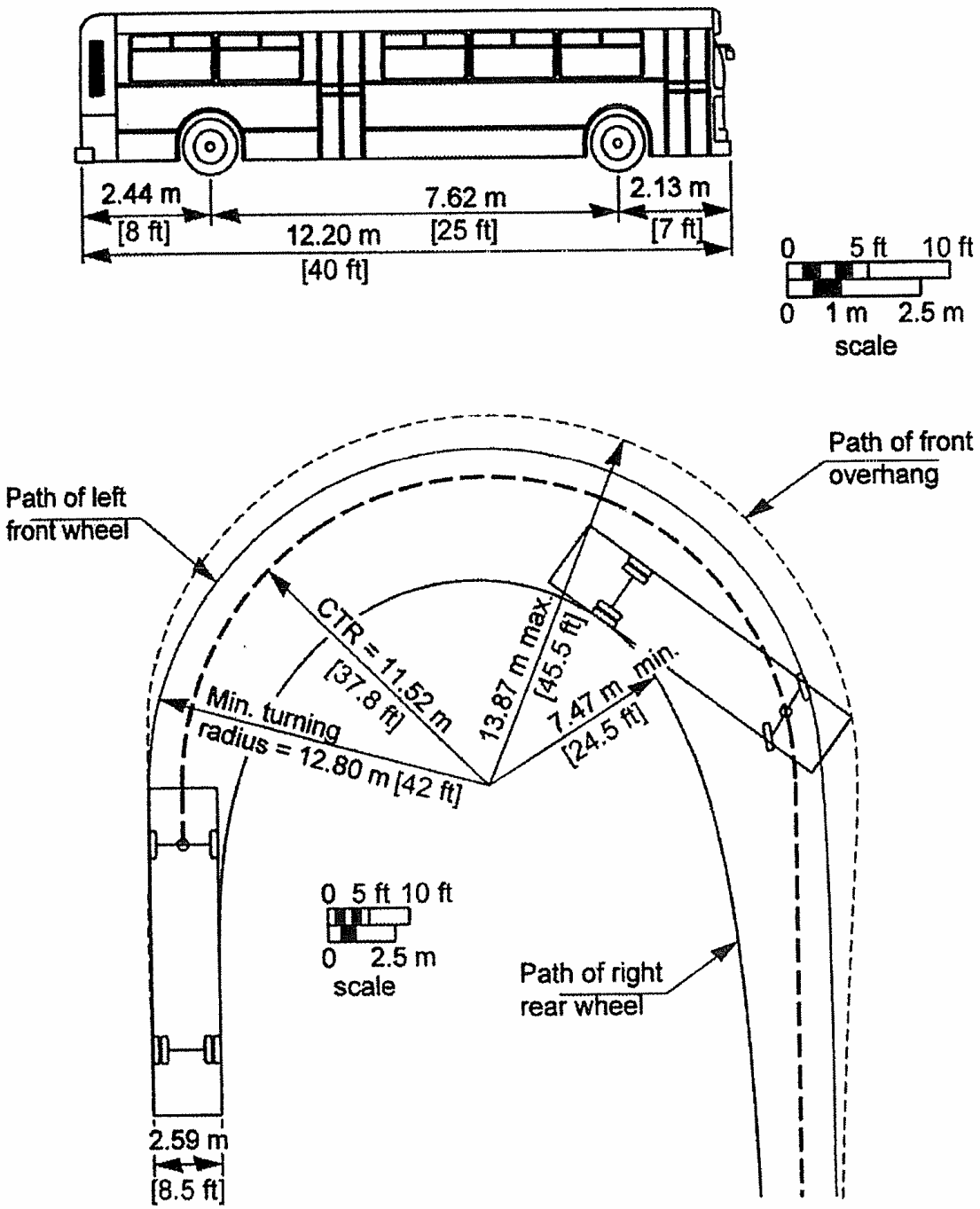
Most modern arterial streets and highways are designed to accommodate buses, trucks, and other large vehicles, and bus drivers have little problem maneuvering on such roadways. However, in office parks, shopping centers, and residential neighborhoods roadway designs are more restrictive. Road sections are narrow in order to make pedestrian crossings easier or to encourage drivers to reduce speeds. This environment can make it difficult for a bus driver to keep the bus in lane, or to avoid hitting or mounting the curb when making a right turn. Streets that are expected to carry bus traffic and facilities designed for bus operation, such as terminals, must be designed appropriately.

Each bus model has different characteristics and has a different turning envelope. When streets or facilities are designed it is not known what exact type of bus will be operating there, so the design bus envelope is established to cover almost all of the vehicles in general service. Turning templates that establish needed clearances are available from many sources. Most of the templates are based on a standard 40-foot long (bumper-to-bumper) transit bus. However, many over-the-road coaches now being produced are 45 feet long. While most of these vehicles can be safely operated within the standard envelope, the specifications provided by the manufacturer should be used when new facilities are designed. Articulated buses are designed to maneuver within the turning envelope of a standard bus.

The figure on the following page illustrates the turning template for a 40-foot bus. The controlling elements for a right turn are the left front bumper, which swings the widest arc, and the right rear wheel, which has the shortest turning radius.

Standard templates for roadway design to accommodate various types of buses are available from several sources and are listed in the selected bibliography on page 46.

40 Foot Bus Turning Template



- Assumed steering angle is 41°
- CTR = Centerline turning radius at front axle

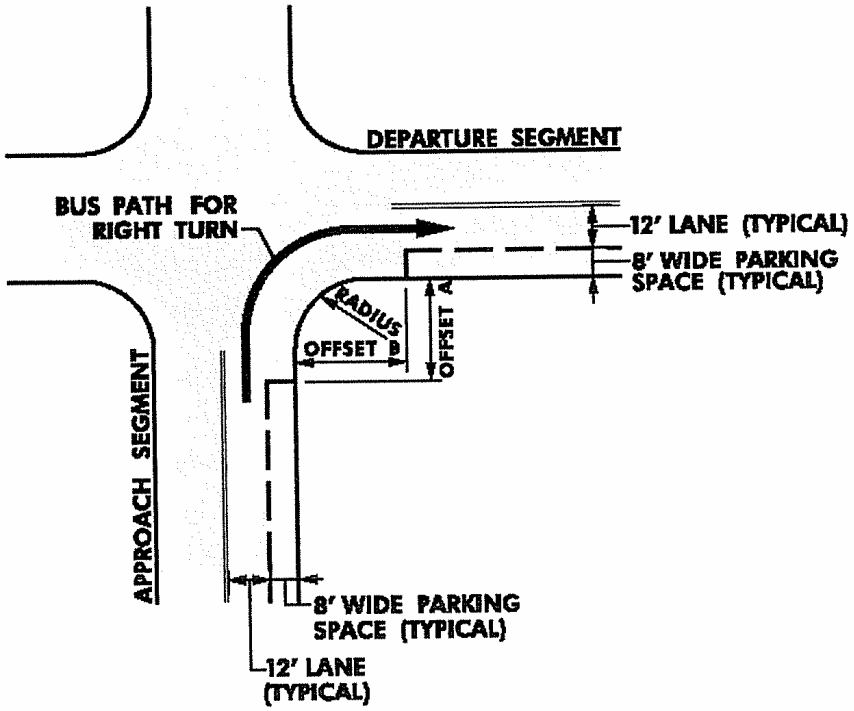
APPENDIX D: INTERSECTION DESIGN

The layout and design of an intersection can significantly affect the ease of transit operations. Intersection design must consider the following elements and how they relate to transit vehicle turning movements:

- Number and width of travel lanes on approach and departure segments.
- The presence of on-street parking on approach and departure segments.
- The offset of the on-street parking on approach and departure segments.

The figure on the next page illustrates the approximate dimensions needed to accommodate a 40-foot-long bus making a right turn. A standard transit bus can navigate a turn with 12-foot lanes without mounting the curb or encroaching on adjacent travel lanes if a 40-foot radius is provided. If there is a parking lane on both approaches or on the departure segment, then the bus will be able to make the turning movement with a smaller radius and without encroaching on adjacent lanes (see Cases 3 and 4 in the table on the next page).

Right Turn Movement for a 40-foot Bus at an Intersection



Intersection Layout	Approximate Dimensions		
	RADIUS	Offset A	Offset B
Case 1: No On-Street Parking	40'	N/A	N/A
Case 2: On-Street Parking Before Turn	40'	35'	N/A
Case 3: On-Street Parking After Turn	35'	N/A	50'
Case 4: On-Street Parking Before and After Turn	30'	40'	55'

There are a number of situations where the roadway conditions may not allow or warrant the radii listed in the table. For example, if there is a local roadway with low traffic volumes, then a smaller radius that facilitates pedestrian movements could be provided. However, if a smaller radius is provided or there is an existing radius that is smaller than those listed in the table, then the bus may encroach on the opposing travel lanes on the departure segment. If there are additional lanes in the same direction on the departure segment, then the radius can be reduced and the bus will simply turn into two lanes.

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3 TCRP Report 19 – Guidelines for the Location and Design of Bus Stops. Transportation Research Board, Federal Transit Administration, 1996, p. 48.

4 Americans with Disabilities Act: Accessibility Guidelines for Buildings and Facilities, Transportation Facilities, and Transportation Vehicles. U.S. Architectural and Transportation Barriers Compliance Board, Washington, DC, 1994, section 4.30.

5 TCRP Report 19 – Guidelines for the Location and Design of Bus Stops. Transportation Research Board, Federal Transit Administration, 1996, p. 43.

6 TCRP Report 19 – Guidelines for the Location and Design of Bus Stops. Transportation Research Board, Federal Transit Administration, 1996, p. 84.

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